

- cn-t  
B  
2
- b. concentrating the solution;
  - c. adding sulfuric acid to the aqueous solution, either before or after step (b) to form a slurry of calcium sulfate in an acidulated solution containing up to about 20 weight percent lactic acid;
  - d. removing at least a portion of the calcium sulfate from the slurry produced in step c.;
  - e. extracting the acidulated solution with an amine extractant that contains sulfuric acid to form a loaded solvent;
  - f. and removing lactic acid from the loaded solvent.
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### REMARKS

Claims 2-12, 14-20, and 22-23 have been canceled. Claims 24-39 have been added. The new claims are supported in the specification as follows:

Claim 24: the specification is generally concerned with recovering lactic acid from an acidulated solution and then recovering the lactic acid from the extractant. Specific basis for the minimum concentration (12 wt-%) of lactic acid in the acidulated solution is found on page 21, lines 8-10.

Claim 25: adding sulfuric acid to an aqueous solution containing calcium is described at page 2 lines 26-27, page 5 lines 8-10 (aqueous solution), page 5 lines 27 et seq. (acidulation of a \*-lactate material containing calcium lactate specifically), and original claim 1. *See also* example 4.

Claim 26: See original claim 1, step (c).

Claim 27: See original claim 2.

Claim 28: See original claims 3 and 4.

Claim 29: See original claim 6.

Claim 30: See original claim 7.

Claim 31: See Table 1 on page 23, and page 30 lines 14-15.

Claim 32: See original claim 8 and pages 13-18.

Claim 33: See original claim 9.

Claim 34: See original claim 11.

Claim 35: See original claim 12 and page 33, lines 18-20.

Claim 36: See original claim 10.

Claim 37: See original claims 1 and 8, and page 21, lines 8-10.

Claim 38: the specification is generally concerned with recovering lactic acid from an acidulated solution and then recovering the lactic acid from the extractant. Basis for the mixture of amine and sulfuric acid is found in original claim 21, among other places.

Claim 39: See original claim 21, and pages 13-18.

Thus, no new matter is added by the amendments to the claims. Claims 1, 13, 21 and 24-39 are currently pending.

### **Rejections under 35 USC § 112, Second Paragraph**

Claims 1-20 and 22 were rejected under 35 U.S.C. § 112, second paragraph as indefinite. Claims 2-12, 14-20 and 22 have been canceled without prejudice. Therefore, the rejection of claims 12, 14, 17 and 22 has been rendered moot. Applicants respectfully submit that the amendments to claim 1 overcome any remaining rejection.

Claim 1, lines 5-6 has been amended as suggested in paragraph 3 of the Office Action. Also, step (a) of the claim has been amended so that the source of lactate material must contain calcium lactate. This removes the basis for the examiner's observations concerning steps (c) and (d) of the claim.

### **Rejections under 35 U.S.C. § 103(a)**

Claims 1-23 were rejected under 35 U.S.C. § 103(a) as obvious over Bailey et al (US 4,771,001), in view of Lenhardt et al (US 5,426,219). Applicants respectfully traverse this rejection.

*Bailey* generally describes a process where lactic acid is recovered from a fermentation broth using an amine extractant. However, *Bailey* does not describe any process in which the solution that is extracted contains calcium lactate. (*Bailey* does describe using calcium salts in the back-extraction. See column 13 lines 16-29, and example 9. However, this is not an acidulated starting mixture as required in the claims of this case.) With respect to claims 1, 13 and 24-35, it is significant that *Bailey* uniformly extracts the lactic acid from dilute aqueous solutions of the acid or its sodium salt. This can be seen in Examples 4-8, where the starting solution contains in each case about 3-4% sodium lactate. Thus, *Bailey* not describe any amine

extraction from a solution containing 12% or more lactic acid, as is required by claims 1, 13 and 24-34.

The secondary reference, USP 5,426,219 to *Lehnhardt et al.*, is relied on by the Examiner to establish that extraction of a more highly concentrated lactic acid solution is conventional. However, *Lehnhardt* does not describe an amine extraction process of any type. Instead, *Lehnhardt* describes a process that uses an oxygenated solvent as the extractant. See *Lehnhardt* claims 1 and 5, for example. Further, in *Lehnhardt's* process, the acidulated starting solution is saturated with a sodium, ammonium or potassium salt of the acidulating acid.

Thus, no combination of *Lehnhardt* and *Bailey* leads to the invention that is the subject of claims 1, 13 and 24-35. All *Lehnhardt* adds to *Bailey* is the knowledge that extractions can be performed at a high starting concentration of lactic acid, if the extractant is an oxygenated solvent and if the acidulated solution is saturated with certain electrolytes. In *Bailey's* process, neither of those conditions exists. Nothing in *Lehnhardt* would suggest that an extraction might be performed at a high starting concentration of lactic acid, when an amine extractant is used. Certainly, nothing in *Lehnhardt* would suggest that there would be any advantage in using a high starting concentration of lactic acid, in an amine extraction process.

The significance of going to a high starting concentration of lactic acid can be seen by reference to Figure 4 of this application. Figure 4 shows the relationship between the lactic acid concentration in the amine (organic) phase after extraction, as a function of the starting lactic acid concentration. Attention is drawn to the line marked by the diamonds, which represents the case where the amine extractant contains no added sulfate (i.e., sulfuric acid). What is notable is that the line is not straight. When the starting lactic acid concentration exceeds about 12%, the line curves upward sharply. This means that it is possible to get an unexpectedly high proportion of the lactic acid to transfer into the amine phase, once the starting lactic acid concentration exceeds about 12%. There is nothing in *Bailey* to suggest this result. As *Lehnhardt* is not concerned with amine extractions, it too fails to suggest that this effect would be achieved.

With regard to claims 36 and 37, neither *Bailey* nor *Lehnhardt* describe extracting lactic acid using a mixture of an amine and sulfuric acid. It is true that *Bailey* describes adding sulfuric acid to a lactic acid or sodium lactate solution, and then extracting with an amine. See, e.g., *Bailey* examples 4-8. However, this is different from the process of claims 36 and 37, where the extractant itself is a mixture of amine and sulfuric acid.

The advantage of using the process of claims 36 and 37 is also illustrated in Figure 4. As discussed above, when no sulfate (i.e., sulfuric acid) is used in the extractant, the efficiency of the extraction improves unexpectedly when the starting lactic acid concentration exceeds about 12 weight percent. However, when sulfuric acid is added to the amine extractant, this effect is seen at even lower concentrations. In Figure 4, this is seen by the very steep slope of curves "B" and "C" at low starting lactic acid concentrations. Again, there is nothing in *Bailey* to suggest that this effect would be seen. It is noted that the Figure 4 starting solutions are already acidulated; i.e., the starting solutions are materials that have been treated with sulfuric acid prior to the extraction step.

Applicants respectfully request withdrawal of this rejection.


#### CONCLUSION

In view of the remarks presented herein, it is respectfully submitted that the claims are in condition for allowance and notification to that effect is earnestly solicited.

Respectfully submitted,

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**Version With Markings To Show Changes Made**

Please make the following changes to claim 1:

1. (AMENDED) A process for generating a purified solution of lactic acid, comprising the steps of:
  - a. providing a source of lactate material which includes [at least one of lactic acid, lactate salt, or both wherein the lactate salt includes] calcium lactate;
  - b. concentrating the source of lactate material by removing at least about 10% of the volume of the volume of the source of lactate materials without [similarly] reducing the [volume] concentration of lactate [material] to form a concentrated solution;
  - c. acidulating the source of lactate material with sulfuric acid to form an acidulated slurry which includes lactic acid and calcium sulfate;
  - d. removing at least some of the calcium sulfate from the acidulated slurry;
  - e. extracting the acidulated solution with an amine extractant to form a loaded solvent; and
  - f. stripping the loaded solvent to provide a purified solution of lactic acid.

In addition, please cancel claims 2-12, 14-20 and 22-23 and add claims new claims 24-39.